

# **NASA Contractor Report**

## **Space Environmental Effects on Spacecraft: LEO Materials Selection Guide**

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**Contract NAS1-19291  
April 1993 through March 1995**

## **FOREWARD**

This report describes the work accomplished under the "Mission Systems Operations Analysis of NASA Space Station Freedom Advanced Concepts (MSOA) contract NAS1-19291, Task 12 (April 1993 through March 1995). Sponsorship for this program was provided by National Aeronautics and Space Administration, Langley Research Center, Hampton, Virginia.

Ms. Joan G. Funk and Dr. Stephen S. Tompkins were the NASA Task Technical Monitors. The following aerospace personnel provided critical support throughout the program:

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## **ABBREVIATIONS, ACRONYMS, AND SYMBOLS**

Å	Angstrom
Al	Aluminum
AL	Anomalously Large
AO	Atomic Oxygen
<i>Ap</i>	Geomagnetic Activity Index (daily)
<i>ap</i>	Geomagnetic Activity Index (3-hourly)
AR	Anti-reflectance
ASTM	American Society for Testing Materials
AXAF	Advanced X-Ray Astrophysics Facility
BOL	Beginning of Life
BRDF	Bi-directional Reflection Distribution Function
C	Centigrade
CAA	Chromic Acid Anodize
CERES	Cloud and the Earth's Radiant Energy System
CLEO	Circular Low Earth Orbit
CN	Cumulative Number
cm	Centimeter
CTE	Coefficient of Thermal Expansion
CVCM	Collectible Volatile Condensable Material
DHW	Double Halfwave
DoD	Department of Defense
DSP	Defense Support Program
DSCS	Defense Satellite Communications System
EDAC	Error detection and correction
EECC	Environmental Exposure Control Canister
EIS	Experiment Initiate System
EMI	Electromagnetic Interference
EPDM	Ethylene Propylene Diene Monomer
ESCA	Electron Spectroscopy for Chemical Analysis
ESD	Electro Static Discharge
ESH	Equivalent Sun Hours
EO	Electro-optical
EOS	Earth Orbiting Satellite
EOL	End-of-Life
EPDS	Experiment Power & Data System
ESA	European Space Agency
EURECA	European Retrievable Carrier
EUV	Extreme ultraviolet
eV	Electron Volt
$F_{10.7}$	10.7 Centimeter Solar Radio Noise Flux
°F	Fahrenheit
FEP	Fluorinated Ethylene Propylene
FEWS	Follow-on Early Warning Satellite
FRECOPA	FREnch COoperative Passive Payload
FTIR	Fourier Transform Infrared

g	gram
GCR	Galactic Cosmic Ray
GEO	Geosynchronous Orbit
GeV	GigaElectron Volt
Ghz	Gigahertz
GPS	Global Positioning System
GSFC	Goddard Space Flight Center
HEO	Highly Elliptical Orbit
HSLA	High Strength Low Alloy
HVI	Hypervelocity Impact
Hz	Hertz
IBEX	Ion Beam Textured and Coated Surfaces Experiment
IDE	Interplanetary Dust Experiment
IR	Infrared
Isc	Short-Circuit Current
ITO	Indium-Tin Oxide
I-V	Current-Voltage
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
K	Kelvin
KeV	Kiloelectron volt
kg	Kilogram
kHz	KiloHertz
km	Kilometer
KSC	Kennedy Space Center
LaRC	Langley Research Center
LMSC	Lockheed Missiles & Space Company
LDEF	Long Duration Exposure Facility
LEO	low Earth orbit
LeRC	Lewis Research Center
LSI	Large-scale integration
m	Meter
MEO	Medium Earth Orbit
MeV	Megaelectron Volt
Mhz	Megahertz
MIL-STD	Military Standard
MLI	Multilayer Insulation
MDSSC	McDonnell Douglas Space Systems Company
mm	Millimeter
M/OD	Micrometeoroids/Orbital Debris
MSFC	Marshall Space Flight Center
MTM	Magnetic Tape Module
mV	Millivolt
MW	Megawatt
NASA	National Aeronautics and Space Administration
nm	Nanometer

OCLI	Optical Coating Laboratory, Inc.
OSO-H	Orbiting Solar Observatory
OSR	Optical Solar Reflector
PL	Phillips Laboratory
Pmp	Maximum Power Point
PTFE	Polytetrafluoroethylene
QCM	Quartz Crystal Microbalances
RCC	Removable Cassette Container
$R_e$	Earth radii
rf	Radio Frequency
RMS	Remote Manipulator System
SAEF-2	Spacecraft Assembly and Encapsulation Facility - 2
SAMPLE	Solar Array Materials Passive LDEF Exposure
sec	Second
SEM	Scanning Electron Microscopy
SEU	Single Event Upset
SEL	Single Event Latchup
SIG	Special Investigation Group
SMM	Solar Maximum Mission
SPENV	Space Environment
SAA	Sulfuric Acid Anodize
SSF	Space Station Freedom
SSM	Second Surface Mirror
SSN	Sunspot Number
TCSE	Thermal Control Surfaces Experiment
TML	Total Mass Loss
TOMS	Total Ozone Mapping System
TRMM	Tropical Rainfall Measuring Mission
UHCRE	High Resolution Study of Ultra-Heavy Cosmic Ray Nuclei
ULE	Ultra Low Expansion
UV	Ultraviolet
UTIAS	University of Toronto Institute for Aerospace Studies
UTRC	United Technologies Research Center
VDA	Vapor Deposited Aluminum
VLSID	Very Large-Scale Integrated Device
$V_{oc}$	Open Circuit Voltage
ZOT	Zinc Orthotitanate
$\alpha$	absorptivity
$\epsilon$	emissivity
$\mu$	micron, micrometer
$\lambda$	wavelengths

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